SAFETY IN MILLING: MAGMA COPPER CO. SUPERIOR, ARIZ.

By Allen D. Look and Ernest R. Rodriguez

* * * * * * * * * * **Information Circular 7623**

UNITED STATES DEPARTMENT OF THE INTERIOR
Oscar L. Chapman, Secretary
BUREAU OF MINES
James Boyd, Director

Work on manuscript completed June 1951. The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is made: "Reprinted from Bureau of Mines Information Circular 7623."

October 1951

Generated on 2024-09-20 07:36 GMT / https://hdl.handle.net/2027/osu.32435030643688
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

SAFETY IN MILLING: MAGMA COPPER CO., SUPERIOR, ARIZ.

by

Allen D. Look[1] and Ernest R. Rodriguez[1]

CONTENTS

	Page
Introduction	1
Acknowledgments	1
Summary	1
General information	1
Safe equipment, guards, and practices	2
Fire protection	2
Housekeeping	2
Dust control	2
Mechanical hazards	2
Electrical hazards	2
Chemical hazards	2
General safety	4

ILLUSTRATIONS

Fig.		Follows page
1.	General view of concentrator, showing fireproof construction of buildings	2
2.	Fire extinguisher inside mill building	2
3.	Interior of grinding-flotation building, showing intermediate floors of steel grating and good housekeeping	2
4.	Dust collector and pipe carrying dust from crusher building	2
5.	Dust-tight housing on crushers	2
6.	Water spray on conveyor, complete enclosure of screen and hood at conveyor transfer point	2
7.	Guard on jaw-crusher drive, flywheel, and shaft end	2
8.	Guard railing along walkways and stairways around thickeners and agitator tanks	2
9.	Main-switch enclosure	2
10.	Reagent-mixing room	2
11.	Vented cyanide-reagent feeder	2

1/ Mining engineer, Bureau of Mines, Phoenix, Ariz.

Information Circular 7623

Generated on 2024-09-20 07:33 GMT / https://hdl.handle.net/2027/osu.32435030643688
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

INTRODUCTION

In the prevention of accidents in milling operations, the proper installation and guarding of electrical and mechanical equipment, safe clearances, good housekeeping, adequate fire protection, adequate ventilation, dust and fume control, and good illumination, as well as safe practices, are essential.

In the new concentrator of the Magma Copper Co., Superior, Ariz., many safeguards were incorporated and safe practices instituted to minimize accident hazards. The purpose of this paper is to describe some of these features and practices.

ACKNOWLEDGMENTS

The authors express their appreciation for the courtesies shown them by the officials and employees of the Magma Copper Co. and for their assistance in enabling preparation of this circular. Acknowledgment is made also of the assistance given by M. L. Williams, safety representative, Bureau of Mines, Phoenix, Ariz.

SUMMARY

Management can indicate support of an accident-prevention program by providing safe operating conditions. Employees cannot be expected to cooperate fully when obvious hazards exist that could be remedied by action on the part of management. In constructing this plant the Magma Copper Co. has applied many of the latest safety and engineering standards in an effort to provide safe conditions.

GENERAL INFORMATION

The new concentrator of the Magma Copper Co., Superior, Ariz., was completed in 1949 and, except for the ore-receiving bins and the conveyors that carry the ore from the bin to the primary crusher, replaced the old mill, which had been in operation since 1914.

Copper and zinc ores are crushed by one jaw crusher and three cone crushers and are concentrated by flotation. Six ball mills and five classifiers comprise the grinding section, and 138 36-inch cells are used in flotation. The crushing section has a capacity of 200 tons an hour and is operated one shift per day; the remainder of the plant has a maximum capacity of 1,600 tons a day with operation on three shifts. An average of 38 men, including the supervising force, are employed.

Grinding and flotation are divided into three sections, two copper sections and a mixed-ore section. The mixed-ore section is designed to handle either copper-zinc ore or copper ore.

Generated on 2024-09-20 07:35 GMT / https://hdl.handle.net/2027/osu.32435030643688
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Alternating-current electric power is delivered to the plant at 2,300 volts, part of which is stepped down by means of transformers to 440 and 120 volts. The crushers, ball mills, and the blower providing air for the flotation cells are operated at 2,300 volts, the electric lights at 120 volts, and the remainder of the equipment at 440 volts.

SAFE EQUIPMENT, GUARDS, AND PRACTICES

Fire Protection

The crusher building and the grinding-flotation building are entirely of steel and sheet-metal construction with concrete floors; thus, the fire hazard is reduced to a minimum (fig. 1). A combination automatic-sprinkler and fire-alarm system is provided for the wooden ore-receiving bins and the wooden structures housing the conveyors that carry the ore to the crushing plant. Fire hydrants are located at various points around the plant and attached fire hoses are racked at each hydrant in boxes that are painted red. Lubricating oils are stored in a separate fireproof building. Carbon-tetrachloride-type fire extinguishers are placed at strategic locations throughout the plant (fig. 2).

Housekeeping

Cleanliness is the keynote about the plant and good housekeeping is practiced (fig. 3). Intermediate floors are of steel grating and the concrete floors on the lowest level have enough slope to be washed easily. A trench on the ball-mill floor carries the spillage and washings to a settling box from which the coarse material can be shoveled into the ball mills. The overflow from the settling box runs down a launder into a trench on the pump floor. This trench also collects spillage and washings from other parts of the building and discharges them into a sump from which the material is pumped back to flotation. The grinding, flotation, and pump sections are washed down at least once every 24 hours.

Small pieces of wood picked off one of the belt conveyors in the crushing plant are thrown into a chute through which they pass into portable containers. Small substantial wooden box-type magazines, suitably painted and marked, are provided at two picking stations on the belt conveyor from the mine ore bins for temporary storage of any detonators that might be found in the ore.

Dust Control

Dust control in the crusher building is provided by a dust-collecting system (figs. 4 and 5) with a 15,000 c.f.m. fan and by water sprays (fig. 6). Crushers, screens, and belt transfer points are hooded and the dust is drawn into the dust collector where water is added to the dust, and the pulp is pumped into one of the classifiers ahead of flotation. The dust collector is equipped with a vibrator to keep the dust from packing and a signal system to give warning if it should become choked. Conveyors in the crusher building have water sprays. The building also has two large roof vents and numerous

Generated on 2024-09-20 07:35 GMT / https://hdl.handle.net/2027/osu.32435030643688
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-20 08:45 GMT / https://hdl.handle.net/2027/osu.32435030643688
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

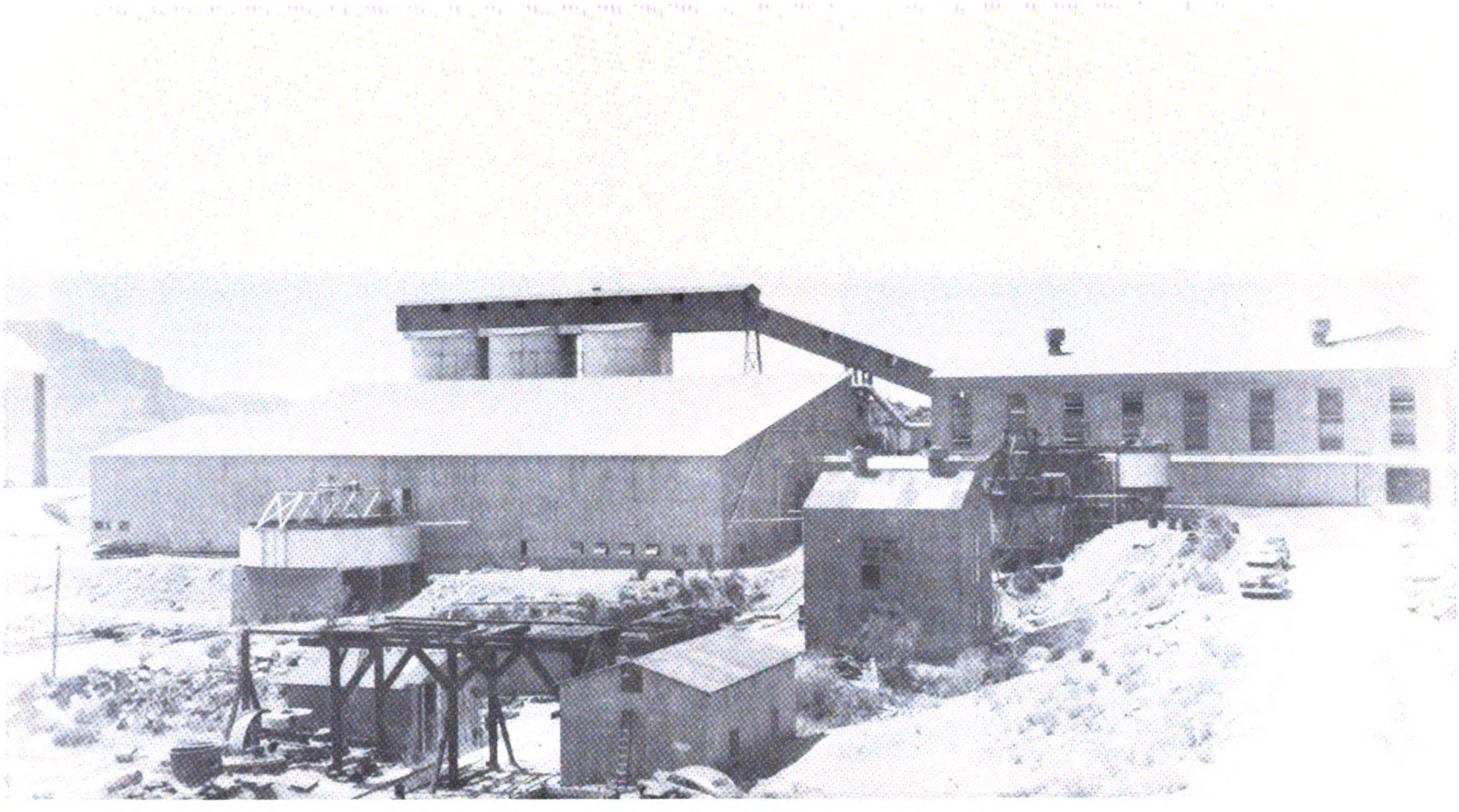

Figure 1. - General view of concentrator, showing fireproof construction of buildings.

Original from THE OHIO STATE UNIVERSITY

Generated on 2024-09-20 07:34 GMT / https://hdl.handle.net/2027/osu.32435030643688
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

Figure 2. - Fire extinguisher inside mill building.

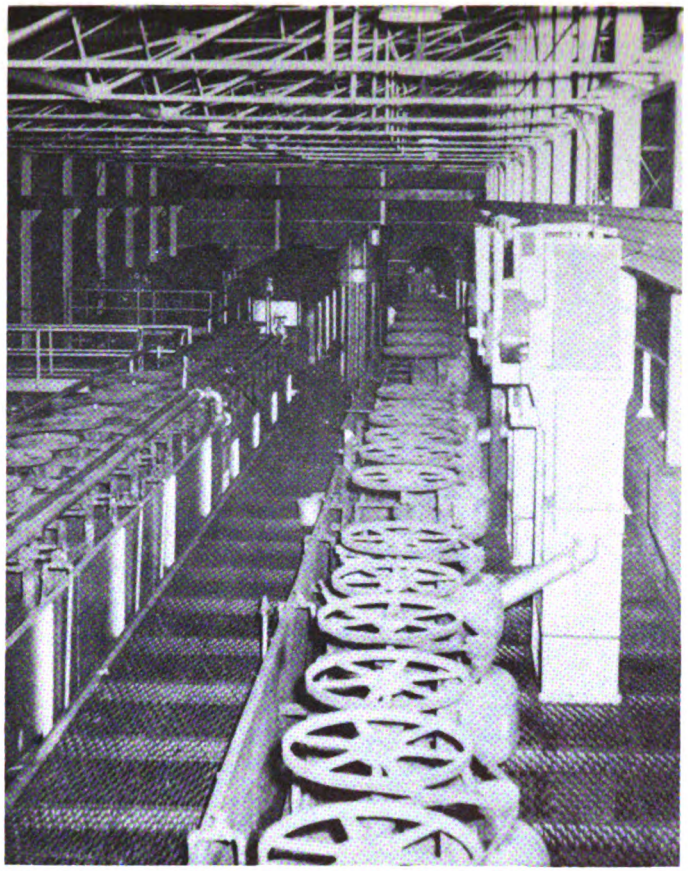

Figure 3. - Interior of grinding-flotation building, showing intermediate floors of steel grating and good housekeeping.

Original from THE OHIO STATE UNIVERSITY

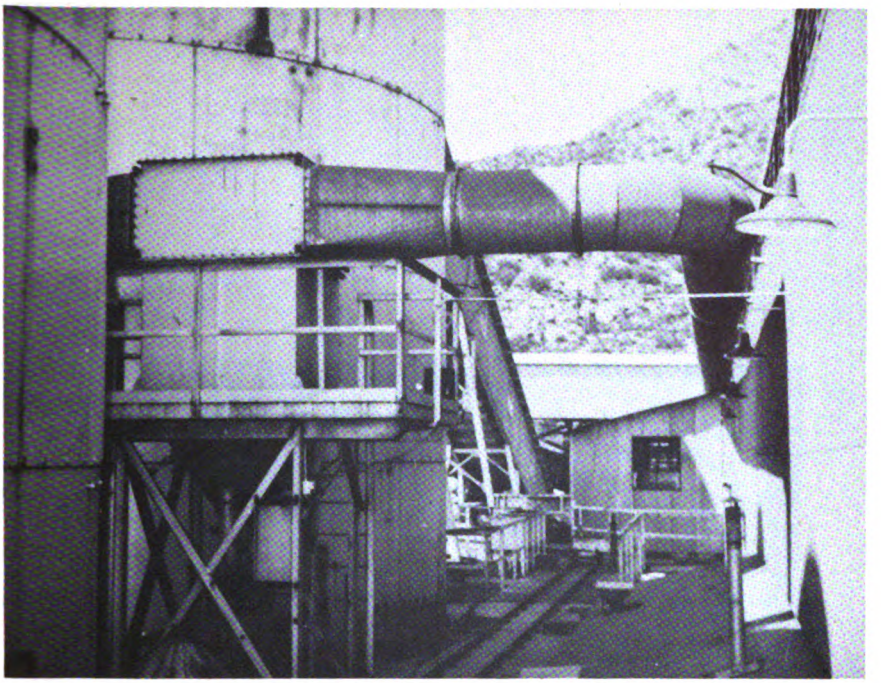

Figure 4. - Dust collector and pipe carrying dust from crusher building.

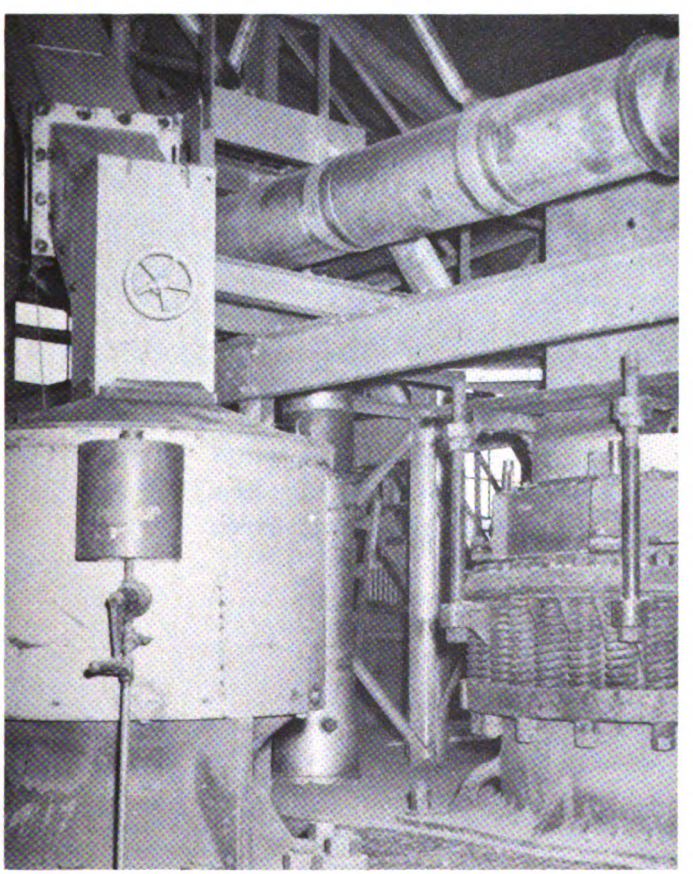

Figure 5. - Dust-tight housing on crushers.

Generated on 2024-09-20 07:38 GMT / https://hdl.handle.net/2027/osu.32435030643688
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

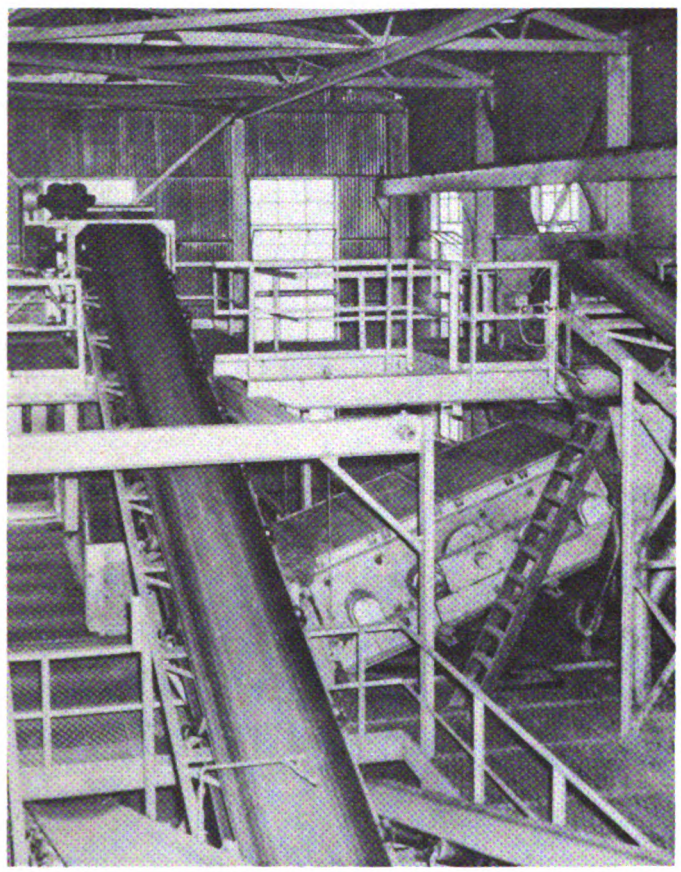

Figure 6. - Water spray on conveyor, complete enclosure of screen and hood at conveyor transfer point.

Generated on 2024-09-20 07:36 GMT / https://hdl.handle.net/2027/osu.32435030643688
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

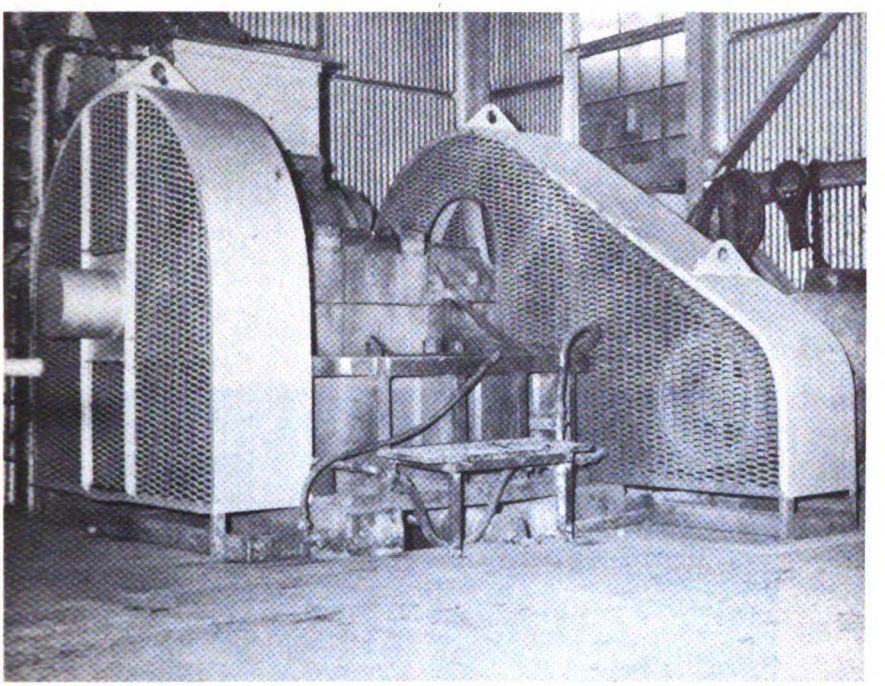

Figure 7. - Guard on jaw-crusher drive, flywheel, and shaft end.

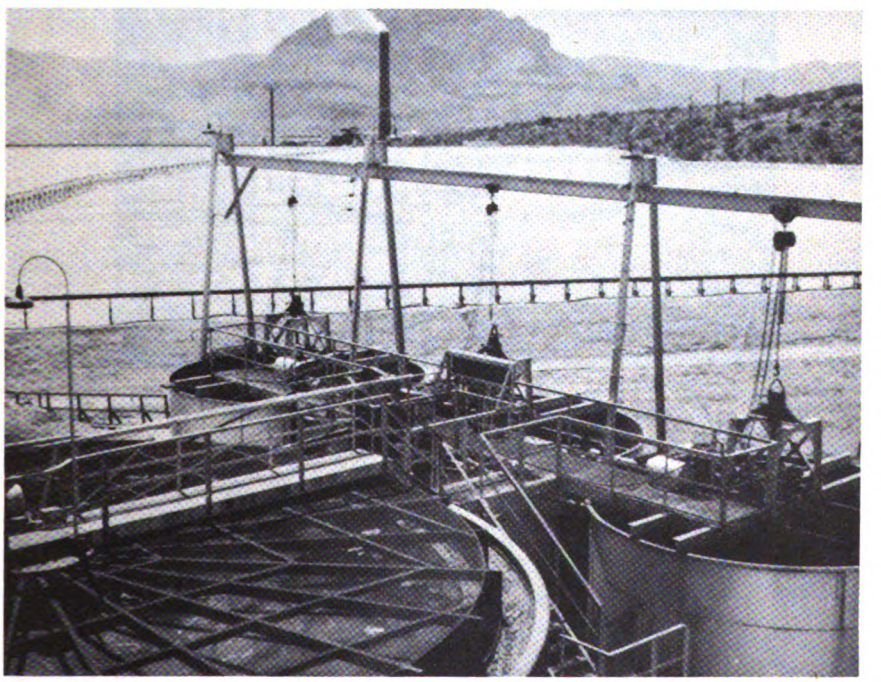

Figure 8. - Guard railing along walkways and stairways around thickeners and agitator tanks.

Generated on 2024-09-20 07:38 GMT / https://hdl.handle.net/2027/osu.32435030643688
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

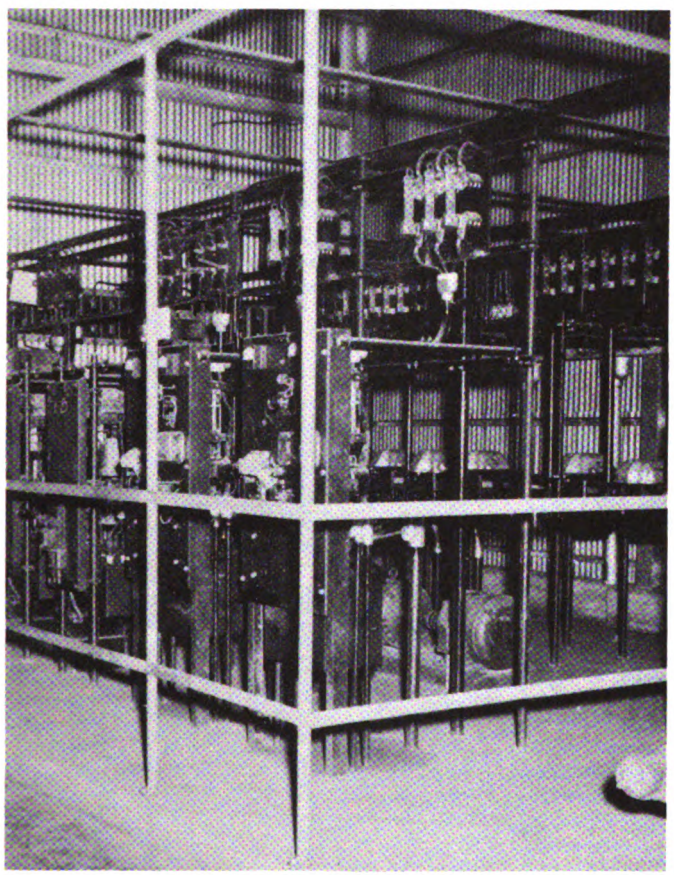

Figure 9. - Main-switch enclosure.

Generated on 2024-09-20 08:57 GMT / https://hdl.handle.net/2027/osu.32435030643688
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
THE OHIO STATE UNIVERSITY

Figure 10. - Reagent-mixing room.

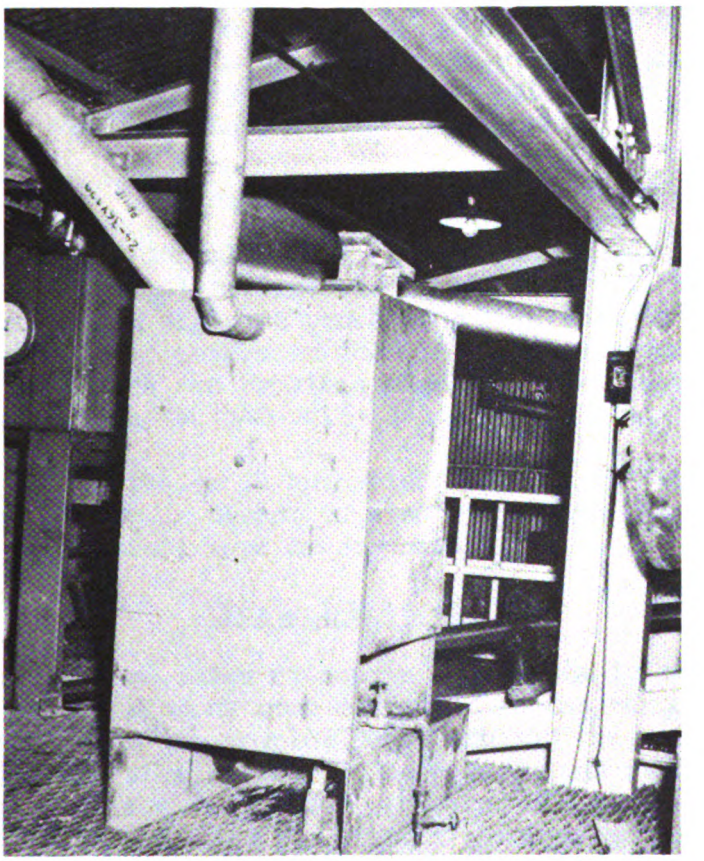

Figure 11. - Vented cyanide-reagent feeder.

Generated on 2024-09-20 07:38 GMT / https://hdl.handle.net/2027/osu.32435030643688
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from
THE OHIO STATE UNIVERSITY

windows, most of which are kept open (see fig. 1). Approved-type respirators are furnished free of charge and all employees are required to use them when working in dusty places. A cooling system, operated during the several months of hot weather common to Arizona desert locations, furnishes cool air to the grinding and flotation sections.

Mechanical Hazards

Substantially constructed guards are installed on moving parts of machinery (fig. 7). A guard is installed to protect employees from the automatic sampler that operates intermittently (every 20 minutes). There are safe clearances and ample walkways, and elevated walkways, platforms, and stairways are equipped with hand-rails (fig. 8) and toeboards where necessary. Extension oil lines are installed where oilers would be exposed to hazard doing necessary oiling during operation.

Switches for stopping the crushing and conveying equipment are provided at the stations where men are required to work. Employees are required to stop equipment before replacing belts or making repairs to machinery. The conveyor-belt motors are controlled by an electrical interlock system so that if one unit is stopped the preceding units will stop also. The equipment can be started only from the switch panel located on the crusher operator's stand, and the switches at each station on the circuit must be in the "run" position. The crusher operator obtains proper clearance over a signal system before starting the equipment.

Overhead traveling cranes with remote control handle the heavy equipment. An electrically operated inclined supply hoist transports supplies from the ground level to the intermediate and top levels of the plant. Riding on this hoist, as well as on conveyor belts, is prohibited, and a warning horn is sounded constantly when the hoist is in operation.

Electrical Hazards

Electrical wiring is installed in a grounded rigid-metal conduit, and all switch boxes, panels, and motor frames are grounded. Switches are clearly labeled and are grouped on separate panels for each section of the plant. Main switches for the large motors in the mill are grouped in a guarded enclosure (fig. 9). Guards are provided wherever there is any possibility of accidental contact with the 440-volt feed wires of the traveling cranes.

Only the plant electrician is authorized to work on electrical wiring or equipment. Where there is danger of electric motors getting wet, they are either of the splashproof type or are hooded.

Chemical Hazards

Flotation reagents are added at only a few points in the circuit. They are mixed in vats in the reagent room and piped to the reagent feeders. Only the lime-reagent mixer and the sampler work with the reagents. When adding reagents to the vats the sampler wears a respirator and rubber gloves (fig. 10). The lime mixer wears a respirator, goggles, and gloves for protection. Cyanide in flake form is fed into the circuit through vented cyanide feeders (fig. 11).

Generated on 2024-09-20 08:44 GMT / https://hdl.handle.net/2027/osu.32435030643688
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Instructions on first-aid treatment for eye injuries caused by lime or other chemicals are posted on the bulletin board.

General Safety

The company safety engineer makes inspections at least once a month, accompanied by an employee of the department. All lost-time accidents are thoroughly investigated and recommendations are made to help prevent their recurrence.

Employees are required to comply with the company printed safety rules, which are issued in pocket-size booklet form. Safety suggestions from employees are solicited, and a box is provided for their collection. Safety posters are displayed on a bulletin board.

General-purpose and special cyanide first-aid kits are provided in the plant, and employees are given Bureau of Mines first-aid instruction. A direct telephone line connects the plant and the company hospital and a sound-proof telephone booth is provided. Instructions are posted in the booth for procedure to be followed in case of emergency.

Goggles are furnished free, and employees are required to wear them when engaged in grinding, chipping, or performing any other work involving danger to the eyes.

Numerous well-placed light fixtures adequately illuminate the plant.

Generated on 2024-09-20 07:44 GMT / https://hdl.handle.net/2027/osu.32435030643688
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY